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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/617,487	07/11/2003	C. Andre T. Salama	SALA:003	2844

7590 12/17/2004
ROSSI & ASSOCIATES
P.O. Box
Ashburn, VA 20146-0826

EXAMINER

LEWIS, MONICA

ART UNIT PAPER NUMBER

2822

DATE MAILED: 12/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No. 10/617,487	Applicant(s) SALAMA ET AL.	
	Examiner Monica Lewis	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 July 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 03 February 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>2/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This office action is in response to the application filed July 11, 2003.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: a) 26 (See Figure 2). Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter (See Claims 8 and 9). See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 2-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is not clear what is meant by the following: a) the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced surface field portion is about 2×10^{12} (See Claim 8); and b) the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2×10^{12} (See Claim 9). It is not clear how the concentration and the thickness are both 2×10^{12} (See Claim 8). Additionally, it is not clear how the concentration and the width are both 2×10^{12} (See Claim 9). Finally, there are no metric units. For example, is it cm^3 or μm .

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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7. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746).

In regards to claim 1, Applicant's Prior Art discloses the following:

- a) a substrate (22) (For Example: See Figure 2);
- b) an epitaxial layer (24) formed on the substrate (For Example: See Figure 2);
- c) a well region (28) formed in the epitaxial layer (For Example: See Figure 2);
- d) a source region formed in the well region (For Example: See Figure 2);
- e) a drain region formed in the epitaxial layer (For Example: See Figure 2); and
- f) a gate region located above at least a portion of the well region (For Example: See Figure 2).

In regards to claim 1, Applicant's Prior Art fails to disclose the following:

- a) a split-drift region located between the source region and drain region.

However, Kitagawa et al. ("Kitagawa") discloses the use of a split-drift region (12 and 13) located between the source region (8) and drain region (10) (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a split-drift region located between the source region and drain region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 2, Applicant's Prior Art fails to disclose the following:

a) the split-drift region comprises a super junction portion and a reduced surface field portion.

However, Kitagawa discloses the use of a split-drift region that comprises a super junction portion and a reduced surface field portion (For Example: See Column 1 Lines 51-55 and Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a split-drift region that comprises a super junction portion and a reduced surface field portion as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 3, Applicant's Prior Art fails to disclose the following:

a) the super junction portion is positioned adjacent to the well region.

However, Kitagawa discloses the use of the super junction portion positioned adjacent to the well region (For Example: See Column 1 Lines 51-55 and Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a super junction portion positioned adjacent to the well region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

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Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 4, Applicant's Prior Art fails to disclose the following:

a) the super junction portion comprises alternately arranged pillars of first and second conductivity types.

However, Kitagawa discloses the use of a super junction portion that comprises alternately arranged pillars of first and second conductivity types (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a super junction portion that comprises alternately arranged pillars of first and second conductivity types as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 5, Applicant's Prior Art fails to disclose the following:

a) the reduced surface field portion is located adjacent to the drain region.

However, Kitagawa discloses the reduced surface field portion is located adjacent to the drain region (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kitagawa discloses the reduced surface field portion is located adjacent to

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the drain region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 6, Applicant's Prior Art fails to disclose the following:

a) the reduced surface field portion comprises a first conductivity type and the substrate comprises a second conductivity type.

However, Kitagawa discloses the reduced surface field portion comprises a first conductivity type and the substrate (1) comprises a second conductivity type (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kitagawa discloses that the reduced surface field portion comprises a first conductivity type and the substrate comprises a second conductivity type as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 7, Applicant's Prior Art fails to disclose the following:

a) the length of the reduced surface field portion is much less than the length of the super junction portion.

However, the applicant has not established the critical nature of the length of the reduced surface field portion is much less than the length of the super junction portion. "The law is

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replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

8. Claims 8 and 9, as far as understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant’s Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746) and Kawaguchi et al. (U.S. Patent No. 6,297,534).

In regards to claim 8, Applicant’s Prior Art fails to disclose the following:

a) the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced surface field portion is about 2×10^{12} .

However, Kawaguchi et al. (“Kawaguchi”) discloses the product of the doping concentration is $1.0 \times 10^{17} \text{ cm}^{-3}$ (For Example: See Column 6 Lines 53-65). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant’s Prior Art to include Kawaguchi discloses that the product of the doping concentration is $1.0 \times 10^{17} \text{ cm}^{-3}$ as disclosed in Kawaguchi because it aids in providing a device with a low on resistance (For Example: See Column 2 Lines 1 and 2).

Additionally, since Applicant’s Prior Art and Kawaguchi are both from the same field of endeavor, the purpose disclosed by Kawaguchi would have been recognized in the pertinent art of Applicant’s Prior Art.

Finally, the applicant has not established the critical nature of the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced

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surface field portion is about 2×10^{12} . "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

In regards to claim 9, Applicant's Prior Art fails to disclose the following:

a) the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2×10^{12} .

However, Kawaguchi et al. discloses the product of the doping concentration is $1.0 \times 10^{17} \text{ cm}^{-3}$ (For Example: See Column 6 Lines 53-65). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kawaguchi discloses that the product of the doping concentration is $1.0 \times 10^{17} \text{ cm}^{-3}$ as disclosed in Kawaguchi because it aids in providing a device with a low on resistance (For Example: See Column 2 Lines 1 and 2).

Additionally, since Applicant's Prior Art and Kawaguchi are both from the same field of endeavor, the purpose disclosed by Kawaguchi would have been recognized in the pertinent art of Applicant's Prior Art.

Finally, the applicant has not established the critical nature of the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2×10^{12} . "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show

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that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

9. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant’s Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746) and Disney et al. (U.S. Patent No. 6,815,293).

In regards to claim 10, Applicant’s Prior Art fails to disclose the following:

a) an oxide layer formed over the split-drift region.

However, Kitagawa discloses the use of an oxide layer over a split-drift region (For Example: See Column 5 Lines 25-30). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant’s Prior Art to include the use of an oxide layer over a split-drift region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant’s Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant’s Prior Art.

b) metal field plates formed on portions of the oxide layer adjacent to the gate region and the drain region.

However, Disney et al. (“Disney”) discloses the use of a metal field plate (164) formed on an oxide layer (169) adjacent to the gate (75) and drain (For Example: See Figure 7c). It would have been obvious to one having ordinary skill in the art at the time the invention was

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made to modify the semiconductor of Applicant's Prior Art to include the use of metal field plate formed on an oxide layer adjacent to the gate and drain as disclosed in Disney because it aids in providing a device that can withstand high voltages (For Example: See Column 1 Lines 15-20).

Additionally, since Applicant's Prior Art and Disney are both from the same field of endeavor, the purpose disclosed by Disney would have been recognized in the pertinent art of Applicant's Prior Art.

Conclusion

10. The following prior art made of record and not relied upon is considered pertinent to applicant's disclosure: a) Yamaguchi et al. (U.S. Publication No. 2003/0222327) discloses a semiconductor device; b) Yamauchi et al. (U.S. Publication No. 2003/0219933) discloses a semiconductor device having an epitaxially filled trench; c) Parthasarathy et al. (U.S. Publication No. 2003/0214009) discloses a resurf super junction device device; d) Onishi et al. (U.S. Publication No. 2004/02112032) discloses a lateral super junction device; e) Onishi et al. (U.S. Patent No. 6,756,636) discloses a lateral super junction device; and f) Kitagawa et al. (U.S. Publication No. 2004/0232483) discloses a field effect transistor.

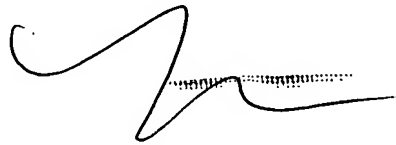
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica Lewis whose telephone number is 571-272-1838. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722 for regular and after final

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communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956

ML

December 2, 2004

A handwritten signature in black ink, appearing to read 'Mary Wilczewski', with a stylized, flowing script.

Mary Wilczewski
Primary Examiner

Sheet 1 of 1

INFORMATION DISCLOSURE CITATION
(Use several sheets if necessary)

Docket Number (Optional) SALA:003

SERIAL NO.: 10/617,487

APPLICANT(s) SALAMA et al.

FILING DATE: July 11, 2003

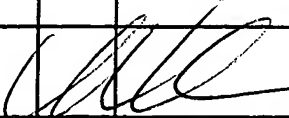
Group Art Unit 2811

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REF	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
ML	US	4,754,310	6/88	Coe	357	13	
ML	US	5,216,275	6/93	Chen	257	493	
ML	US	5,438,215	8/95	Tihanyi	257	401	
ML	US	2003/0190789	10/03	Salama et al.	438	286	

OTHER DOCUMENT(S) (Including Author, Title, Date, Pertinent Pages, Etc.)

ML	"High Voltage Thin Layer Devices (Resurf Devices)"; J.A. APPELS et al.; IEEE International Electron Device Meeting (IEDM); Dig. Tech Papers; pp. 238-241; 1979.
ML	"Theory of a novel voltage-sustaining layer for power devices"; X.B. CHEN et al.; Microelectronics Journal, Vol. 29; pp. 1005-1011; 1998.
ML	"COOLMOST™ - a new milestone in high voltage Power MOS"; L. LORENZ et al.; Proceedings of the 11 th International Symposium on Power Semiconductor Devices and ICs (ISPSD); pp. 3-10; 1999.
ML	"Super Junction LDMOST in Silicon-On-Sapphire Technology (SJ-LDMOST); Sameh NASSIF-KHALIL et al.; International Symposium on Power Semiconductor Devices and ICs (ISPSD), Proceedings; pp. 81-84; 2002.
ML	"170V Super Junction - LDMOST in a 0.5 μm Commercial CMOS/SOS Technology"; S.G. NASSIF-KHALIL et al.; International Symposium on Power Semiconductor Devices and ICs (ISPSD), Proceedings, accepted for publication; 4 pages.
ML	"Extended (180V) Voltage in 0.6 μm Thin-Layer-SOI A-BCD3 Technology on 1 μm BOX for Display, Automotive & Consumer Applications"; A.W. LUDIKHUIZE et al.; International Symposium on Power Semiconductor Devices and ICs (ISPSD), Proceedings; pp. 77-80; 2002.
ML	"A Versatile 700-1200-V IC Process for Analog and Switching Applications"; Adriaan LUDIKHUIZE; IEEE Transactions on Electron Devices, vol. 38; pp. 1582-1589; 1991.
ML	"Experimental Results and Simulation Analysis of 250V Super Trench Power MOSFET (STM); T. NITTA et al.; International Symposium on Power Semiconductor Devices and ICs (ISPSD), Proceedings; pp. 77-80; 2000.
ML	"Super-Junction LDMOST on a Silicon-on-Sapphire Substrate"; S. NASSIF-KHALIL et al.; IEEE Transactions on Electron Devices, Vol. 50, No. 5; May 2003; pp. 1385-1391.

EXAMINER 

DATE CONSIDERED 7/24/04

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Notice of References Cited	Application/Control No. 10/617,487	Applicant(s)/Patent Under Reexamination SALAMA ET AL.	
	Examiner Monica Lewis	Art Unit 2822	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-2003/0222327	12-2003	Yamaguchi et al.	257/500
	B	US-2003/0219933	11-2003	Yamauchi et al.	438/156
	C	US-2003/0214009	11-2003	Parthasarathy et al.	257/492
	D	US-200402112032	10-2004	Onishi et al.	257/491
	E	US-6,756,636	06-2004	Onishi et al.	257/342
	F	US-20040232483	11-2004	Kitagawa et al.	257/335
	G	US-6,815,293	11-2004	Disney et al.	438/268
	H	US-6,297,534	10-2001	Kawaguchi et al.	257/341
	I	US-6,777,746	08-2004	Kitagawa et al.	257/335
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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